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# The Role of Small Islands in Marine Subsistence Strategies: Case Studies from the Caribbean

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**Abstract** Caribbean archaeologists have tended to focus exclusively on the prehistory of the largest islands, perhaps because large islands are believed to provide the landmass necessary to support long-term population growth and cultural development. Yet, as research here and elsewhere, e.g., the Pacific, is showing, small islands provided access to resources and landscapes that were not always readily available on the larger islands. Small islands often have superior terrestrial and, especially, marine resources; isolated ritual spaces; and more easily defended locations; although they are susceptible to more rapid overexploitation. This paper examines in detail human needs with regard to island size, demonstrating that small islands were crucial in the development of pre-Columbian Caribbean societies. Four case studies are presented to illustrate that small islands often were preferred over large islands throughout the Caribbean archipelagoes. Finally, these studies show that the prehistoric exploitation and overexploitation of small islands can provide significant insights for establishing baselines that can be used for modern management and conservation efforts.

**Keywords** Archaeology · Island biogeography · Coral reefs · Small islands · Caribbean

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## Introduction

Archaeologists have for decades used the theory of island biogeography (MacArthur and Wilson 1967) to structure their investigations of the prehistoric settlement of islands (e.g., Terrell 1986, 2006; Fitzhugh *et al.* 2004). The theory does provide testable hypotheses concerning the diversity and distribution of species on islands; however, it gives preference to large islands. Large islands present more substantial targets for colonizing species, are characterized by more diverse terrestrial habitats which colonizing species can occupy and/or adapt, and they provide the potential to support a greater number of species throughout their lives.

"Islands" in the ecological sense include systems that may be widely separated by physical barriers—for example mountain tops, isolated ponds or wetlands, or even shallow bank systems separated by deep ocean passages. The operative word is "systems", and different ecological systems can scale quite differently in terms of measurables such as biological diversity, species abundance, or ecological production. MacArthur and Wilson (1967) address diversity and body size of primarily vertebrates, but the theory of island biogeography does not address functional production in ecological systems and the underlying differences between ecological region's potential to feed humans.

Thus, it is critical to understand the island "system" in reference to the support system for colonizing humans.

Yet human cultures are different from their animal counterparts. As a result, the observed outcomes of human colonization of islands often do not match the biological expectations of the theory (Keegan and Diamond 1987). One reason is that humans living on islands tend to rely heavily on marine resources. In this regard, the distribution of marine habitats and the species they support may be more important than the size of the island. In fact, the distribution of marine foods is independent and often the inverse of island size such that small islands may provide access to more substantial marine resources than do larger islands. Ironically, although this has not received a great deal of attention from archaeologists, it has been widely known by marine ecologists, conservation biologists, and those whose livelihoods have depended on the sea for survival.

One of the main objectives of this paper is to demonstrate that island size does not necessarily matter in elucidating human occupation and colonization. What is far more important is the distribution of subsistence items whether they are on land or sea. Smaller islands have been exploited (and in many cases, extremely taxed) by humans through time as a result of their often-richer resources. What really matters is the nature of the integrated "system"—that is, the island and its associated coastal shelf or bank system. The associated bank system of island and shallow marine habitats will support a density and diversity of marine resources based on the spatial scale, complexity, and availability of nutrients. Proxies for island ecological productivity can be bank area, extent of shorelines or perimeter and rainfall; these three factors contribute to the spatial complexity of coastal and shallow water habitats, and thus, the variety of marine resources that might be available for people.

Indeed, one of the most fascinating aspects of Caribbean archaeology is the widespread use of small islands (Fig. 1). Obviously, "small" is a relative term, but a comparison of smaller versus larger islands reveals that the smaller islands were often settled first. For example, there are early Ceramic Age settlements in the U.S Virgin Islands (with a combined surface area of 344 km$^2$) and Montserrat (84 km$^2$), while these are absent in many of the larger islands in the Lesser Antilles (e.g., St. Lucia; Keegan 2004). In addition, all of the small islands along the windward, east coast of St. Lucia

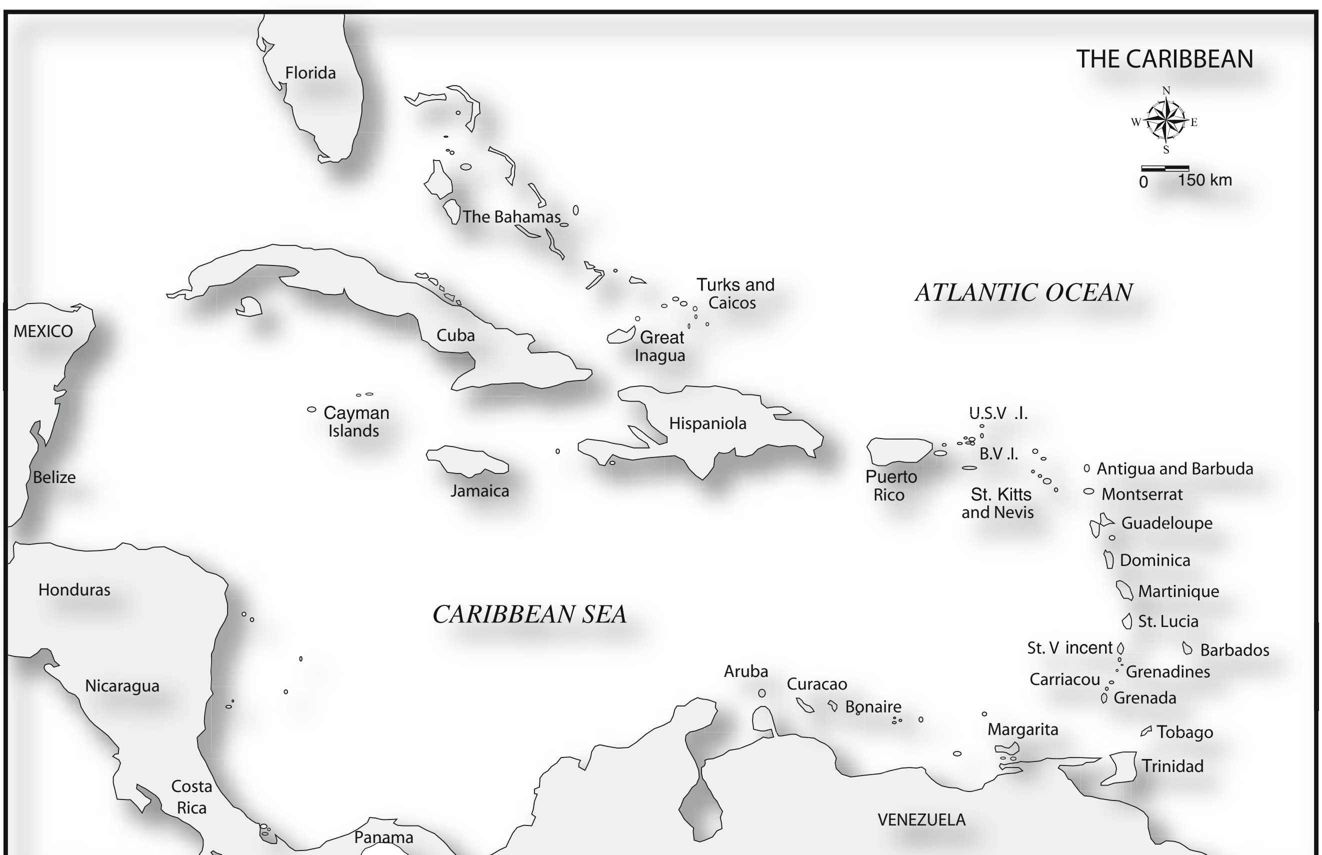


**Fig. 1** Map of the Caribbean

(e.g., Dennery, Praslin, Frigate) have substantial surface scatters of post-Saladoid (ca. after A.D. 500/600) ceramics despite being less than 1 km$^2$, as do Île à Rat off the north coast of Haiti, numerous small cays in the Bahama archipelago (e.g., Middleton Cay, Long Cay, Horse Cay, Dove Cay, Cotton Cay, Pelican Cay, Ambergris Cay, and Gibbs Cay in the Turks and Caicos Islands), and those in the Grenadines such as Petite Martinique and Union.

With the possible exception of the Cayman Islands (Scudder and Quitmeyer 1998; Stokes and Keegan 1998), most of the small islands of the Caribbean were intensively exploited during prehistory. It often has been assumed that the pre-Columbian peoples of the islands had limited impacts (e.g., Pandolfi *et al.* 2003), and that small islands with supposedly less accessible marine habitats provided nursery areas and refuges from which marine species could be recruited to replenish the depleted stocks of larger islands. We now know that this is not true, and that the original inhabitants of the islands had substantial impacts with long-term consequences for the structure of marine and terrestrial communities (Carlson and Keegan 2004; Fitzpatrick and Keegan 2007; Fitzpatrick *et al.* 2007b; Steadman and Stokes 2002).

In this study we focus on four cases where Ceramic Age horticulturalists occupied small islands. We examine the Turks and Caicos Islands (Grand Turk and Middle Caicos), each of which are sufficiently large to support modern populations. Next we explore Carriacou in the Grenadine Islands to evaluate the same phenomenon in the Lesser Antilles. Finally, we turn to several very small cays in the Turks and Caicos Islands that were occupied by Ceramic Age peoples throughout prehistory, but were never settled by post-contact residents. Our goal is to demonstrate that the size of the land area is often less important than the size of marine resources associated with a particular island, which has made smaller islands especially attractive places for humans to exploit over the millennia (e.g., Allen and Schubel 1990; Ambrose 2002; Burley *et al.* 2003; Weisler 2003; Takamiya 2006; Jones *et al.* 2007). We begin with a general consideration of how islands are conceived, proceed to a consideration of farming and foraging by native peoples in the Caribbean, and then turn to our four case studies that focus on the prehistoric use of small islands. We then complement our study with more recent marine ecological data to examine the potential that smaller islands have for understanding resource use and potential impacts through time. Our overall objective is to refocus the study of Caribbean archaeology, and hence, island regions in general, to consider more closely the characteristics of islands and their surrounding marine habitats with regard to human needs, versus an emphasis on island size as the deciding factor in island colonization. As greater recognition of the role of island size and resource areas is achieved, we can begin to develop better models for how resources were exploited in smaller island environments through time, construct baselines for examining changes and impacts to coral reef nurseries, and analyze the implications that these and other islands have for human settlement and conservation management.

## The Concept of Islands

It is possible to conceptualize an island as simply an area of land surrounded by water. This notion of islands privileges terrestrial landscapes as the most important human habitats and promotes the view that the sea is less hospitable. However, most island archaeologists today, including those in the Caribbean, recognize that the sea can be a highway that facilitates movements between islands. Watters and Rouse (1989) demonstrated this point by showing that artifacts across water passages often were more similar to each other than those found on either end of the same island (a phenomenon also seen in places such as Indonesia, for example [see Lape 2004]). Callaghan (2001) has documented the seafaring abilities of native West Indians using computer simulations, showing that movements between islands were not as difficult as landlubbers might imagine. And Samuel Wilson (2001) introduced a projection of the islands with west at the top, which creates a visual image of the circum-Caribbean as a smaller and more accessible region. Finally, Torres and Rodríguez Ramos (2008) have remapped the Caribbean based on the intervisibility of islands to create what they call a "continent of islands." All of these studies contribute to a perspective in which the islands of the Caribbean were really not that isolated or difficult to reach prehistorically (Keegan 2004), although there may be a few exceptions such as Jamaica (Callaghan 2008).

As important as those studies are for changing our perceptions of Caribbean islands, they still maintain an emphasis on the land, its distribution, and access between landmasses. As mentioned previously, archaeologists tend to visualize islands as areas of land surrounded by water (cf. Callaghan 2001). Following from the principles of island biogeography (Keegan and Diamond 1987), bigger is better. Larger islands present a more visual target (although the vast, shallow banks of the Bahama Archipelago reliably generate highly visible, tell-tale cloud formations through evaporative convection), they support a greater diversity of habitats and a wider range of species usually inhabits them. Larger islands are more stable platforms for settlement and provide additional refuges from the catastrophic hurricanes that torment the Caribbean every year. On an evolutionary time scale, the species that inhabit larger islands are more likely to survive.

Yet there is a different way of looking at islands. Marine biologists view islands as landmasses that support a diversity of habitats ranging from coral reefs, mangroves, seagrass beds, estuaries, seaward reef flats, lagoonal patch reefs, lagoonal sand flats, sea walls and surge channels, both sandy and rocky shores, and supralittoral or littoral pools. From this perspective, the length and characteristics of the coastline are often more important than the area of the island. Various fishes exploit the coral reefs associated with islands, and fishes and mollusks inhabit the shallow-water seagrass, mangrove, and littoral habitats. For these species it is not the terrestrial habitat per se that is crucial to their survival, it is the marine habitats associated with islands that are of primary importance. We suggest that a more marine-centric perspective needs to be considered. Although marine resources in general are now being seen as increasingly important components to the biological and cultural evolution of humans (see Erlandson 2001), for islands it is less so. This is especially important in cases where the human inhabitants of the landmass relied heavily on marine resources—such is the case for the Caribbean.

There are also issues of time and use. Larger islands do provide greater stability and the potential for more complex cultural and ecological systems. However, we need to ask whether the first inhabitants of an island viewed their new home as the place for cultural evolution according to anthropological constructs, or whether they were just trying to optimize their ability to achieve an accepted standard of living. Animal examples are again worth considering. For example, sea turtles use islands as a place to lay their eggs, as do some birds (e.g., Audubon's shearwater, the Sooty Tern, and many species of gull) which forage over the open ocean and establish rookeries on islands; sea mammals (e.g., the now extinct Caribbean monk seal) also exhibit similar behaviors. Islands are for them necessary, but only temporary habitats in their reproductive cycle.

Humans can act in similar ways. They may live on an island for a relatively short period of time and then move on to another island. They can visit an island to take advantage of the seasonal abundance of a particular resource, and they can live permanently on an island and survive by exchanging the abundant marine resources of that location for terrestrial foods that cannot be obtained on the island (e.g., Harding 1967; Hofman *et al.* 2006). We will consider each of these cases in the discussion that follows. In addition, because so little is known about the economics of the peoples who inhabited the islands before about 500 BC (see Fitzpatrick and Keegan 2007; Newsom and Wing 2004; Keegan 1994, 2000), we will limit our focus to the Ceramic Age cultures as described by Rouse (1992). Moreover, we will focus on several specific cases to illustrate our point that island size cannot be equated only with terrestrial land masses and the importance they have in understanding human exploitation.

## How Small is Small?

There are a variety of social and cultural factors that influence the colonization of islands by humans (e.g., Keegan 1992, 2004; see also Anderson 2006; various papers in Fitzpatrick 2004). We are going to ignore several of these for the moment and focus exclusively on the economic relations between people and islands. There are several ways to approach this issue. We can look at total, average, or marginal returns to production and each of these provide somewhat different answers (Keegan 1986). Our discussion may seem pedantic, but it is worth working through the logic of all three.

Total returns to production are the easiest to calculate and reflect long-term outcomes while ignoring short-term decision making (e.g., Curet 2005; Newsom and Wing 2004). Let us start with lowland South America from which the first Ceramic Age colonists came, even though South America is by modern definition considered a "continent" (but since 75% of the Earth's surface is water, this too could essentially be labeled an "island", albeit with a huge land area). There are numerous case studies of particular cultures here, but the most influential has been Robert Carneiro's (1970) study of cultural evolution and the "Origin of the State." His is a classic example of grand schemes (and looks at total versus average or marginal indicators) where he noted that relatively large, permanent, and autonomous villages inhabited by slash-and-burn horticulturalists in the densely populated Xingu region of Amazonia tend to be located 10 to 15 miles apart (Carneiro 1970: 21). In this scenario every village had sufficient resources within their territory to support their way of life without recourse to the territory of their neighbors. In essence, Carneiro is describing cultural islands, each with an area of about 80 square miles (ca. 200 $km^2$).

We need to restrict our scope because early Ceramic Age peoples only settled as far north as Puerto Rico, but judging the early Ceramic Age Caribbean from Tropical Forest standards, we would expect early major settlements (the total number is given in parentheses) on Guadeloupe (8), Martinique (5), Dominica (4), St. Lucia (3), Barbados (2), St. Vincent (2), Grenada (1), Antigua (1), Puerto Rico (44). Clearly, this does not reflect the settlement patterns for the early Ceramic Age (see Bradford 2001; Haviser 1997; Keegan 2004). It is immediately evident that our underlying assumption that island area by itself, as compared to lowland South America, reflects the settlement decisions that were made by the initial Ceramic Age colonists as inaccurate and perhaps inappropriate.[1]

[1]It may seem that we have set up a straw-man argument, but many Caribbean archaeologists rely heavily on South American ethnographies (e.g., Roe 1995; Siegel 1999).

There are a variety of reasons why this simple application of geographic arithmetic failed to give the desired result. First, all of the islands are different and we would expect the colonizing peoples to evaluate and adapt to these differences. Second, the Ceramic Age peoples were preceded by Archaic peoples who may have depleted some resources on particular islands (Veloz Maggiolo and Ortega 1976). Third, the emphasis on land area, to the exclusion of marine resources, created false expectations.

The third possibility is especially compelling because the cultural groups considered by Carneiro (1970) relied on the tropical forest for all of their subsistence needs. In contrast, Caribbean groups of similar cultural heritage had the vast resources of the sea with which to supplement their diet. Unfortunately, there are no specific estimates of the relative importance of terrestrial and marine foods in Caribbean diets. A review of tropical forest groups suggests that plant foods contribute somewhere between 50% to 75% of the diet (Keegan 2000). Because the Caribbean Islands have a depauperate terrestrial fauna, the majority of animal protein in the diet must have come from the sea. Based on stable isotope analysis (Schoeninger 1985; Keegan and DeNiro 1988; Stokes and Keegan 1998; Norr 2002) and faunal assemblages (Keegan 1992; Newsom and Wing 2004), a generous estimate for the contribution of terrestrial products (primarily plants) to the diet is 60%.

Using the relative contribution of marine to terrestrial as 40% to 60%, we can recalculate the land area needed to support an autonomous group over a substantial period of time. The land area is now reduced to 120 km$^2$. As a result, we would now expect the following number of early Ceramic Age sites by island: Guadeloupe (14), Martinique (9), Dominica (7), St. Lucia (4), Barbados (1), St. Vincent (3), Grenada (3), Antigua (2), St. Kitts (1), British Virgin Islands (1), Barbuda (1), Nevis (1), U.S. Virgin Islands (3), Puerto Rico (74). But, the archaeological data still do not fit the predictions of our admittedly simple model (but see Curet 2005). There are early Ceramic Age sites on Montserrat and St. Martin, but these islands are smaller than the minimum size calculated using a modified tropical forest habitat. Our conclusion at this point is that size or smallness is not dependent on the area of landmass.

## Catchment Analysis

A different approach to the question of size uses the premises of catchment analysis. This approach begins with the resources identified in site deposits (often animal bones or shellfish remains), and then looks at the habitats surrounding a site to determine the area in which such resources could be captured. Using this approach, Wing and Scudder (1983) concluded that all of the resources in Bahamian sites could be captured within a 5 km diameter catchment (20 km$^2$).

There are two main problems with this type of analysis. First, although the habitat supporting a resource may be available within the site catchment, it can not be assumed that similar habitats outside the catchment were not also exploited. For example, although there may be soils suited for agricultural production within the catchment, this does not exclude the possibility that similar agricultural lands adjoining the catchment were also used. In this regard, the evidence for settlement spacing in lowland South America would seem to provide a better approximation of the land area needed for agriculture.

Second, catchment size often is based on equal access to habitats. It has been shown, however, that different terrains and different modes of transportation can have a significant impact on travel time between habitats and patches. For example, it took WFK and his research crew about 1 h to traverse the 3.5 km walk through the forest to work at site MC-6 on Middle Caicos. In comparison, Columbus reported that Taíno canoes could travel at up to 6 knots per h (11 km). Even if the native peoples could walk faster, or traveled by canoe at a slower rate of speed, the disparity suggests that marine habitats were far easier to reach and exploit than were those located in the tropical woodlands. In this regard, the catchment areas, based on equivalent access, would have far greater marine components than terrestrial components, especially for settlements located near the coast. The point is that even if terrestrial environments provided more of the total returns to production in terms of caloric inputs, the marine environments offered easier access and covered a wider area of a site's catchment.

If we take a hypothetical site located on the shore, and assume that most of the resources were captured within an area circumscribed by 2 h of travel time, then we get the following results with regard to the relative areas of marine and terrestrial habitats: the land area composes half of the catchment and is all within a 7 km radius of the site (ca. 75 km$^2$), while the marine environment is composed of a 20 km radius and incorporates over 600 km$^2$. These estimates suggest that sites should be spaced between 15–40 km apart to prevent encroachment on another site's catchment. It is interesting that these linear distances (9 to 24 miles) are similar to Carneiro's (1970: 21) report that autonomous tropical forest communities are spaced at 10 to 15 mile intervals.

Other factors could reduce the hypothetical size of the catchment area necessary to support insular settlements. For example, Carneiro's (1970) analysis of tropical forest communities was done in a context in which humans had been foraging the area's resources for millennia. This was not always the case in the Caribbean, particularly early in the human colonization process. The Bahama archipelago was virtually uninhabited until after AD 1000. As such, the first settlers would have encountered a near-pristine ecosystem that had never been subjected to meaningful human predation. Anthropologists have long understood that an island's first settlers initially go after all of the "low hanging fruit" (see Kirch 2000: 61–62 and Steadman 2007 for a discussion of anthropogenic overexploitation of insular Pacific avifauna) before turning their attention, out of necessity, to resources that are more distant, more difficult to obtain, or of lower social or nutritional value (Keegan 1986). Consequently, it is reasonable to expect that earlier sites in this region could be spaced more closely together as their occupants collected the highest ranked resources before expanding their foraging activities further afield (Carlson and Keegan 2004). Therefore, the *timing* of the occupation should be considered when examining site placement in island environments.

## Resource Availability and Subsistence Strategies

### Farming

Thus far our exercise has been based on purely mathematical grounds. Obviously one needs to consider the specifics of different habitats in the vicinity of a site and not simply treat the environment as a uniform plain. Moreover, even if the calculated catchment size reflects equal transportation costs, we still need to consider whether the travel time accurately reflects resource exploitation.

Early Ceramic Age peoples are characterized by the cultivation of a variety of root crops (e.g., manioc and sweet potatoes) and the capture of marine sources of animal protein (e.g., fish and mollusk) (Newsom and Wing 2004). If we assume that they were egalitarian and largely autonomous (Siegel 2005), then we would expect that every community would be self-sufficient in at least the capture of the foods they required. In most cases, the extensive marine component of the hypothesized catchment should provide more than enough protein to satisfy human requirements. The limiting factor would seem to be terrestrial habitats on which calories could be produced in sufficient quantities.

One estimate, based on tropical forest horticulture, is that every family cultivated a 1 ha plot to provide sufficient produce (Keegan 1986, 1992). These fields would have continued to produce at adequate levels for at least 4 years after which new fields had to be cultivated. Allowing 20 years of fallow for each field before it was recultivated, we get an estimate of 5 ha per family as the long-term sustainable area of cultivation. Roosevelt (1980: Table 1) estimates that manioc cultivation can yield 14.2 million calories per hectare. However, production will decrease over the 4-year life of a garden. Using a conservative estimate of human caloric needs (2,000 calories per person per day), it would be possible theoretically to support 19 adults on 1 ha of land per year. Using the values of 10 ha/km$^2$, a 2 h walk from a village would encompass 75 km$^2$, and allowing 5 ha per family, this area is sufficient to support a village of 2,850 people in perpetuity. This number is far greater than we would expect for any single village during the initial Ceramic Age settlement of the Caribbean.

In terms of numbers, Levy (see McArthur *et al.* 1976) estimated that 400 people are the minimal sustainable human population. In other words, long-term survivability required a minimum population of 400 to ensure reproductive viability. If we assume that we are dealing with a single, endogamous community (an unrealistic assumption), and given the high caloric productivity of manioc, then 400 people could be supported on only 10 km$^2$! Obviously we are presenting an idealized landscape in which all of the land is equally productive. Nevertheless, these estimates show that land area was not particularly limiting during the initial Ceramic Age settlement of the islands. Under ideal conditions, a village of 400 people living on the coast would have all of the arable land that they needed within a 1 h walk from their village (a three km radius which yields about 14 km$^2$ or 140 ha).

These estimates admittedly are crude, but they suggest that any island with arable land totaling 14 km$^2$ could support a reproductively viable human population in perpetuity and impose no need for people to venture elsewhere. During the colonization of these islands, it is likely that the size of any community was magnitudes smaller. Thus, this exercise shows that even tiny islands (e.g., Saba with an area of only 13 km$^2$) could have supported human settlements even if people were marooned there with no hope of ever leaving its shores.

Of course, the indigenous peoples who colonized the Caribbean would never consider themselves castaways. They were habitual, accomplished seafarers with a deep maritime tradition. If we allow for the fact that they could, at will, traverse open expanses of water with minimal effort, then the minimum island size necessary to support their communities shrinks even more. Let us continue to assume that all of a community's arable land falls within a single hour's journey of the settlement. Now assume that journey is by canoe. As mentioned above, Columbus observed that indigenous watercraft traveled at a pace of 11 km/h. If we take a conservative approach and trim that rate by a fourth (to 8 km/h) that results in a 200 km$^2$ area around the settlement that lies within an hour's journey. It is likely that much (probably most) of that area will be water; but of that 200 km$^2$, a maximum of 14 km$^2$ (7%) needs to be arable land, and perhaps even less. The assumption is that the cultivation of any particular piece of land would not be random (any more than a fisherman would arbitrarily drop a line or cast a net into the sea).

**Table 1** Bank classification areas and perimeters for the Bahamian archipelago

| Bank type | Bank name | Bank area ($km^2$) | Bank perimeter (km) | Island area ($km^2$) |
|---|---|---|---|---|
| Sheltered | Western Great Bahama | 35,564 | 704 | 5,124 |
| | Caicos | 6,856 | 375 | 489 |
| | Eastern Little Bahama Bank | 6,053 | 302 | 1,359 |
| | Eleuthera | 5,191 | 317 | 448 |
| | Crooked and Acklins | 3,034 | 258 | 758 |
| | Cat Island | 1,917 | 233 | 354 |
| | Long Island | 1,698 | 220 | 485 |
| Sheltered with cays | Central Bahamas | 14,586 | 538 | 586 |
| | Berry Islands | 2,473 | 144 | 45.3 |
| Island occupied | Great Iguana | 962 | 229 | 1,479 |
| | San Salvador | 780 | 142 | 149 |
| | Mayaguana | 599 | 144 | 268 |
| | Rum Cay | 511 | 104 | 83 |
| | Samana | 339 | 100 | 33.5 |
| | Little Iguana | 335 | 99 | 113 |
| | Plana Cays | 206 | 61 | 16.2 |
| | Conception Island | 16 | 18 | 7.9 |
| Fully exposed | Southern Great Bahamas | 33,389 | 753 | 29.4 |
| | Cay Sal | 6,040 | 306 | 8.8 |
| | Silver Banks | 2,833 | 226 | 0 |
| | Mouchoir | 958 | 149 | 0 |
| | Turks Islands | 607 | 137 | 22.7 |
| | Navidad | 434 | 83 | 0 |
| | Mira Por Vos | 134 | 44 | 0 |
| | Hogsty | 133 | 47 | 1 |
| | Brown | 83 | 38 | 0 |
| Anomalous | Western Little Bahama | 8,716 | 353 | 1,112 |
| Totals for the archipelago | | 134,447 | | 12,972 |

The entire archipelago includes 134,447 $km^2$ of shallow-water marine habitats, this is a larger bank system that all other Caribbean islands combined.

Rather, they would pick and choose the most productive plots, "foraging" for good land the same way they sought out the most productive reefs and conch beds across the region. Higher productivity per plot means less land required for cultivation—how much less, however, is difficult to quantify. Nevertheless, this scenario, while specific, demonstrates that having as much as 14 $km^2$ of arable land within walking distance of a village need not be a limiting factor in site selection. Given the right set of circumstances, settlements could be situated on islands that were merely large enough for the village itself. All of the gardens could be situated on suitable land elsewhere that easily was reached by canoe (e.g., Harding 1967). Although a variety of social, cultural, and environmental factors need to be factored into the equation (Keegan 1992, 2004), at this point it is worth considering the potential contribution of the marine environment. The land-sea interface is a somewhat artificial division of habitats, and on small islands, the integrated ecological unit would include the island-bank system. The geomorphology of the island and its associated shallow bank system (to 200 m) will determine the overall productivity and diversity of the area (Sullivan Sealey and Bustamante 2000).

## Marine Habitats

The insular Caribbean is classically subdivided into three island groups: the Greater Antilles, Lesser Antilles, and the Bahamian archipelago. The availability of marine resources for each of these island groups can be characterized by three factors: (1) The overall area of shallow water habitat, (2) the extent of island perimeters (e.g., kilometers of shoreline) and (3) rainfall patterns. The production of shallow water marine life will be very high on the island-bank system of Cuba, for example. This island has a complex shoreline with extensive off shore cays and embayments. Critically, Cuba has surface water resources and sufficient rainfall to create extensive coastal wetland and estuarine environments. This spatial extent and complexity of habitats supports a wider diversity and abundance of both benthic invertebrates and finfish. But, rainfall is also critical. Columbus described Guantanamo Bay as one of the most impressive harbors he had seen, but the area around the mouth of the bay lacked permanent human settlement probably due to the paucity of rainfall (Sara and Keegan 2004).

The Lesser Antilles would likely have the lowest island-bank productivity of the three island archipelagos simply because the associated bank systems of each island are quite small. There are few submerged bank systems to support extensive shallow-water habitats such as seagrass beds and corals reefs. The major exceptions are the extensive shallow banks of Saba and Anguilla, and especially the Grenadines between Grenada and St. Vincent (Fig. 2).

The Bahamian archipelago is a group of carbonate bank-island systems with common geological origins (Sullivan Sealey 2004), with less and more variable rainfall than the other island groups. The Bahamian archipelago stretches over 6° of latitude, thus climate can vary from hot and dry environments in the south to cooler and wetter climates in the extreme north. In this massive archipelago, there are five distinct types of bank-island system, each with unique assemblages of marine and terrestrial organisms (see Fig. 3). The sheer size of the bank systems would support larger populations of marine species, such as queen conch (Table 2), that are no doubt highly aggregated on spatial scales, but nevertheless have greater reproductive potential than smaller bank populations.

Large sheltered bank systems such as Caicos Bank or Long Island provided the spatial extent and diversity of habitats to support high abundances of marine life. Unlike terrestrial resources or farmed crops, marine resources might be highly patchy and concentrated in unique geographic features (e.g., mangrove creek systems). Studies of southern stingray feeding in the central Bahamas illustrate this point (Gilliam and Sullivan 1993). Benthic surveys of sandy bank areas adjacent to the Exuma Cays with grabs, cores, and benthic sleds indicated a relatively low density of infaunal invertebrates such as mollusks, polychaetes, and crustaceans. However, the stomach contents of the foraging stingrays caught in the same areas held about twice the number of species, and large numbers of individuals. The foraging techniques of an 80-kg stingray allowed the animal to identify patches of high density food items; the energetics of the animal would not be supported by densities mapped in random benthic surveys.

Mangrove creeks and coastal wetlands are also associated with a concentration of marine resources close to land. However, there is a great deal of variability among creek systems based on the spatial extent of the system as well as the size and proximity of associated seagrass beds (Nero and Sullivan Sealey 2005). The size, species composition, and seasonal changes in fish assemblages are all related to basic habitat features of mangrove creeks.

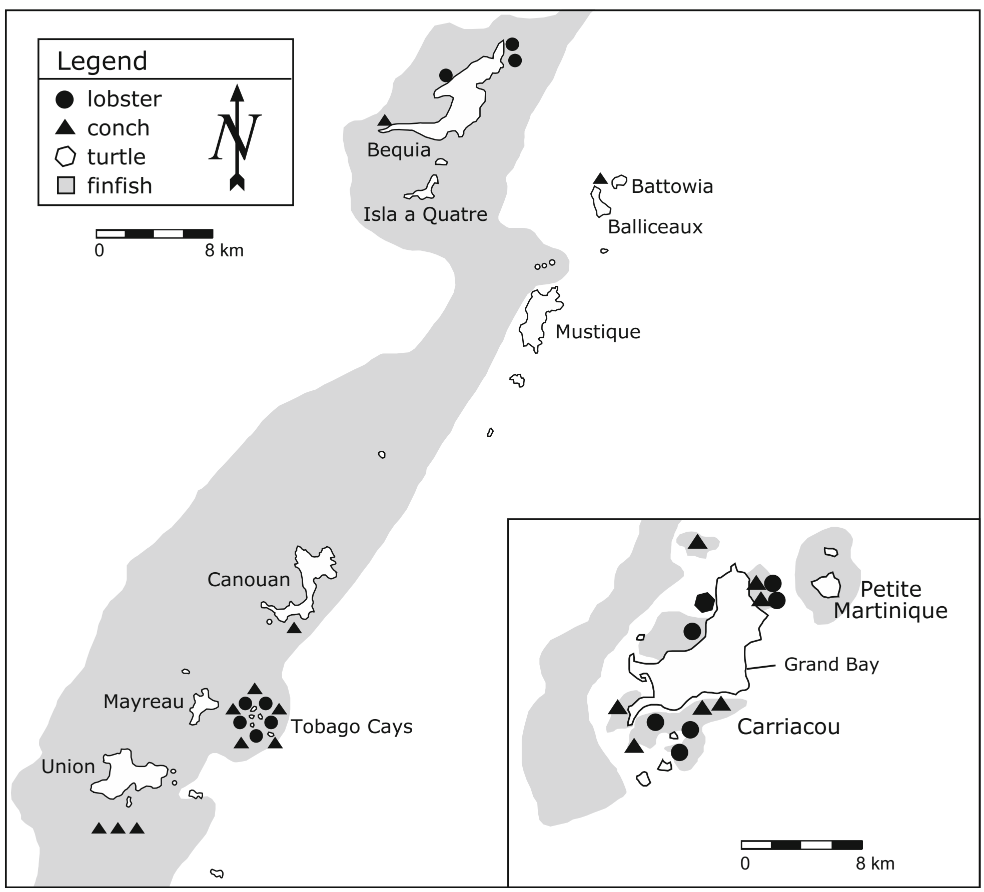


**Fig. 2** Resource data map of the Grenadines with *inset* of Carriacou

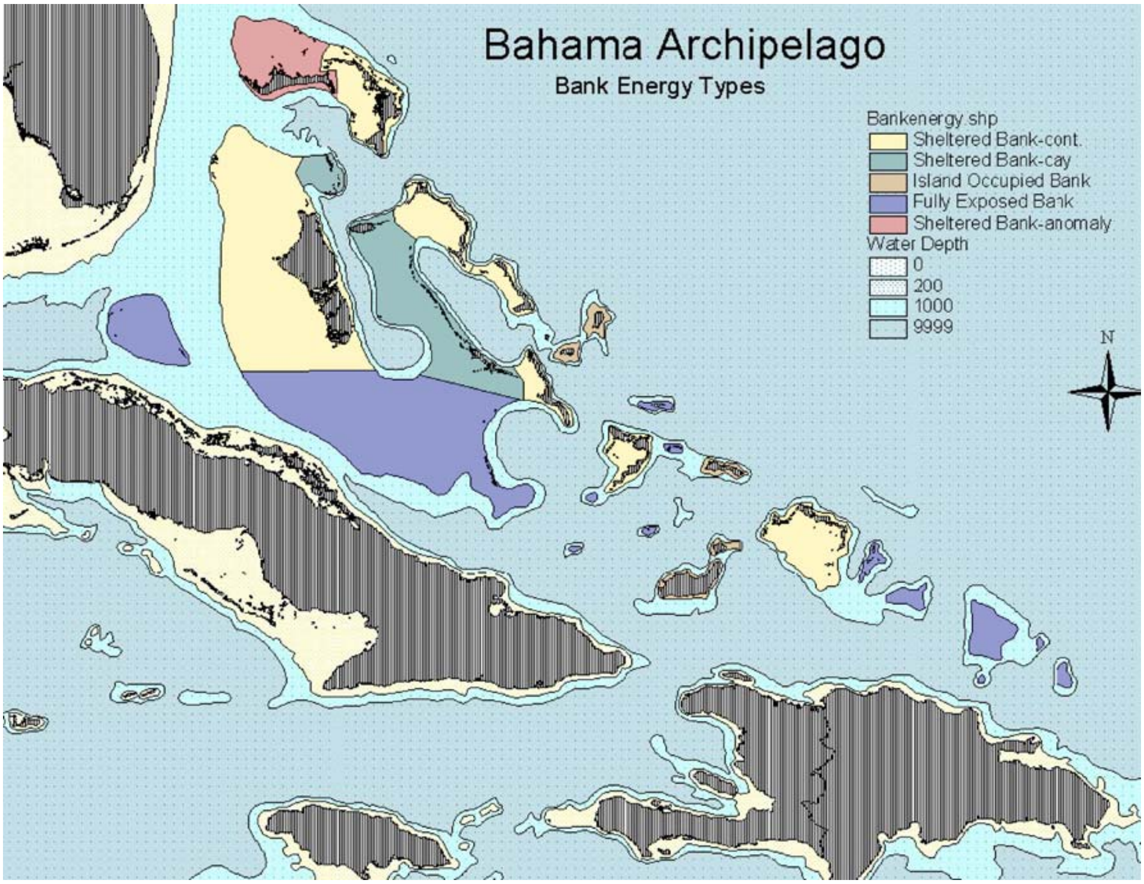


**Fig. 3** Diagram of the bank energy types for the Bahamian Archipelago. The archipelago is made up of a carbonate bank system with a common geological origin, however, the size and placement of islands along the platform margin impact the spatial extent and diversity of the associated shallow-water marine resources. Large sheltered-bank systems are particularly important in creating extensive wetlands and estuarine environments along the low-energy western margins (e.g., Andros, Abacos and Caicos Bank)

In sum, although there is a diversity of marine habitats in the Caribbean, small islands often are associated with the most productive marine habitats. Prehistoric and historic populations were drawn to these areas and the archaeology of small islands may tell us more about patterns of exploitation than do settlements on the larger islands.

## Small Island Case Studies

The preceding discussion highlighted the fact that small is a relative term. Islands with access to only 14 km$^2$ of arable land could have been settled permanently, small land areas can be associated with more substantial marine resources

**Table 2** Modern comparison of adult queen conch (*Strombus gigas*) densities (no. individuals/ha) between locations in the wider Caribbean (adapted from Delgado 1999)

| Location | Density (no./ha) | Reference |
|---|---|---|
| Bermuda | 0.52 | Berg *et al.* (1992) |
| Florida Keys, U.S.A. | 0.50 | Berg *et al.* (1992) |
| Bahamas (fished) | | Smith and van Nierop (1984) |
| Little Bahama Bank | 28.50 | |
| Great Bahama Bank | 20.79 | |
| Cuba | | Alcolado (1976) |
| Diego Perez | 1,582 | |
| W. Caicos Bank | 255 | Hesse (1979) |
| SW Puerto Rico | 2.62 | Torres Rosado (1987) |
| PNE, Dominican Republic | 1.60 | Delgado (1999) |
| Los Roques, Venezuela | | Weil and Laughlin (1984) |
| Fished | 160 | |
| Protected | 1,886 | |

Limited field data is available for The Bahamas, but densities suggest that the number of conch that once existed in the archipelago would have been several time the populations from smaller bank systems.

than larger islands, and there is a need to consider the distribution of islands with regard to travel time. For example, there are sites on Nevis that are in closer proximity to sites on St. Kitts (albeit across water passages) than they are to other sites on Nevis. There also are social and cultural factors to be considered. Many small islands could support autonomous, self-sufficient settlements, but others were likely specialized sites that were part of a wider regional economy.

We have selected four cases to illustrate the main uses of small islands. First, Grand Turk, which has the earliest known site in the Turks and Caicos, as well as two sites associated with craft specialization in bead manufacture. Second, MC-6 on Middle Caicos illustrates the integration of small island communities within a larger, regional context. Third is Carriacou, which provides an example of an early and autonomous village with two exceptionally large settlements compared to other large islands in the southern Lesser Antilles. Fourth are several small, currently unoccupied cays in the Turks and Caicos Islands. Other cases could be cited, but our present effort focuses on examining these four cases to demonstrate the importance of these islands and surrounding resources prehistorically and their exploitation during more recent times.

## Grand Turk

Grand Turk is located about 120 km north of Hispaniola at the southeastern end of the Bahamian archipelago (Fig. 4). The island measures about 10 km north–south by 3 km east–west, with an area of about 30 km$^2$. These numbers are deceptive, however, because about a third of the island is inland lagoons and salinas, which reduce the total land area to about 20 km$^2$. There are two freshwater sources on the island—one at "north wells" and the other at "south wells." For much of its modern history, the shallow salinas on Grand Turk were used for salt production. The island has an arid climate, which is excellent for salt production but not well suited for agriculture. There are no farms, and only a few house gardens on the island today.

There are three main sites on Grand Turk. The oldest is the Coralie site (GT-3), which has calibrated radiocarbon dates ranging from AD 700–1100. All of the pottery in the site is executed in the Ostionan style and all of it was imported from Hispaniola (Cordell 1998). There is evidence that the site was occupied for short periods of time over a span of about 400 years with particular areas of the site dating to different centuries (Carlson 1999). Details concerning the site's characteristics and the faunal remains have been presented elsewhere (see Carlson 1999; Carlson and Keegan 2004).

The Coralie site exemplifies the use of a small island as a temporary base for resource extraction. The faunal assemblage is unique for the Caribbean, consisting of a substantial number of iguanas (including, in the oldest deposits, "giant" *Cyclura carinata*, almost 50 cm larger than the 80 cm used today as their maximum size), adult green sea turtles (*Chelonia mydas*), a loggerhead turtle (*Caretta caretta)* estimated to weigh about 500 kg, an extinct tortoise (new

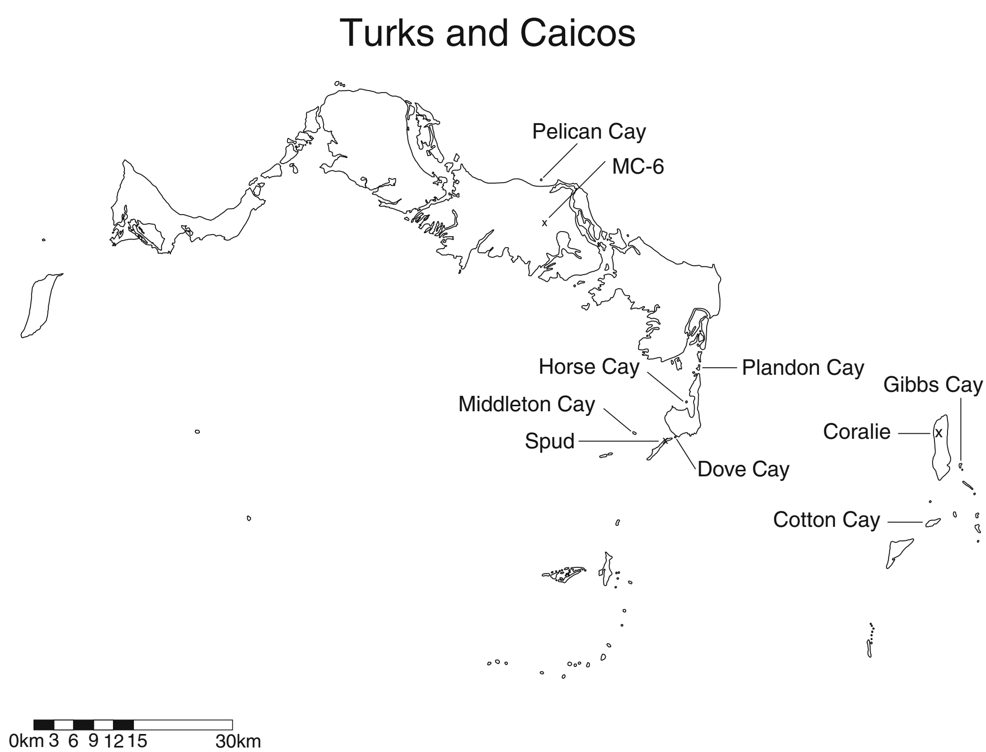


**Fig. 4** Map of the Turks and Caicos Islands

to science and as yet unnamed), large fishes, and very few mollusks. One of the unique characteristics of the site is that the carapace of the green turtle was used to cook meals. The excavation of these turtle hearths revealed that a variety of animals were cooked in these shells. This was not simply the rendering of turtle meat because the hearths also contain iguana and fish bones. Similar cooking practices have not been identified at any other Caribbean site.

The faunal remains and associated radiocarbon dates and artifacts suggest that the Coralie site reflects the first human use of Grand Turk. The marine and terrestrial animals in the site are far superior to those available in Hispaniola at the time (Carlson and Keegan 2004) and support the conclusion that a 2-day canoe trip from Hispaniola was compensated by access to exceptional animal resources. Thus, the seasonal and temporary use of Grand Turk provided both meats for export to Hispaniola and the opportunity to further investigate the islands of the Turks and Caicos.

Here is a classic example of economics at work. Keegan (1992) calculated the marginal return rates for Caribbean fauna and found that the highest ranked species were sea turtles and iguanas (the lowest were mollusks). The very high rates of return for these animals suggest that the returns from their capture far outweighed the costs of getting to Grand Turk. The result was average return rates that greatly exceeded those available on Hispaniola at the time. Going to Grand Turk from Hispaniola to harvest turtles, iguanas, large fishes and later tortoises made good economic sense.

At about the time that the Coralie site was abandoned (ca. AD 1100), two new sites were established on the island. These again contain only pottery that was brought from Hispaniola, but this time in the Meillacan style (Carlson 1993). These sites (GT-2 and GT-4) also appear to be seasonal camps, but instead were used for the purpose of manufacturing shell disc beads from the thorny jewelbox shell (*Chama sarda*).[2] The faunal assemblages lack the iguanas, tortoises, sea turtles and large fishes found at Coralie. Instead there is a focus on grunts (*Haemulon* sp.), which are relatively small, but common reef fishes (Carlson 1993). Moreover, the abundance of head parts in the assemblage suggests that these fishes also were being preserved by smoking or salting for export to Hispaniola.

Sites were also established on Middle Caicos at this time. MC-8 and MC-10 on the south coast of Middle Caicos have been radiocarbon dated to cal AD 1160±50 (Beta 146874), and they too show evidence for specialized bead manufacture (Sinelli 2001). But perhaps more important than beads, the Middle Caicos sites provide immediate access to the vast Caicos Bank where conch and lobster fishing sustained the Turks and Caicos economy for years.

The sites on Grand Turk illustrate the specialized use of small islands. The oldest site was a temporary and probably seasonal camp at which the superior resources of this, until then, pristine island were captured and exported to Hispaniola. Following a significant decline in the resource base, the island was used for specialized craft production (shell beads) and led to the permanent settlement and exploitation of resources on other islands in the Turks and Caicos around AD 1100 (Keegan 2007). Islands like Grand Turk probably played a significant role in the earliest phases of exploration and exploitation (Berman and Gnivecki 1995; Irwin 1992; Keegan 1995) on which later and more permanent settlements developed.

## Middle Caicos

Middle Caicos is located at the center of the Caicos Islands above the heart of the Caicos Bank (Fig. 4). The Caicos Bank is a 6,856 km$^2$ shallows that supports abundant populations of *Strombus gigas* and other seagrass-associated fish and mollusks (Doran 1958). The island measures about 120 km$^2$, although about a third of this area is seasonally flooded salina along the south coast. It has a relatively dry climate, but there are sufficient soils and rainfall to support subsistence agriculture. As mentioned above, the island was first settled in the twelfth century AD. Four main sites have been identified thus far (MC-6, MC-12, MC-32, and MC-36), although more than 44 locations with evidence of prehistoric activities also have been identified (Keegan 2007; Sullivan 1981). At issue in this case study is the integration of small islands in the regional economy. The key site is MC-6, which was occupied around AD 1400, and shows strong ties to the *cacicazgos* (regionally-integrated chiefdoms) of Hispaniola.

MC-6 is also unique in comparison to other sites in the Caribbean. It is the only site north of the Greater Antilles with a central court and astronomical alignments (Alegría 1983; Sullivan 1981). In addition, there are eight semi-pit structures with stone foundations located around the central plaza. The use of stone in house construction has not been observed at other sites in the region. The question then is why this small and otherwise insignificant island is the location of a site that shares more with Taíno sites in the Greater Antilles than it does with Lucayan sites in the Bahamian archipelago (Keegan 1997).

The most important feature of MC-6 is that it is located near Armstrong Pond, which produces solar distilled salt during the summer months. The site is connected to the pond by a 1-km long aboriginal road. Sullivan and his crew demonstrated in 1987 that hundreds of tons of salt could be harvested annually, suggesting that salt was an important

[2] Very limited surface collections and testing have been conducted at GT-4, but the results to date suggest that it is very similar to GT-2 in timing and composition.

dietary supplement for tropical agrarian peoples and that raw salt was being exported to Hispaniola (Sullivan 1981).

A different conclusion emerges when one considers the main characteristics of a regionally integrated polity. The first settlements in the Caribbean are considered to be autonomous and egalitarian (Siegel 1999). In this regard, every community was its own island, and the inhabitants of each settlement procured all of the resources necessary for survival. But at the time of European contact, chroniclers describe regional polities in which a paramount chief (*matunherí*) was at the apex of a settlement hierarchy that included district chiefs and the leaders of individual settlements (Redmond and Spencer 1994; Wilson 1990). Such regional polities emerge under particular conditions involving the assembly of men for warfare and the redistribution of economic goods involving systems of staple and wealth finance (D'Altroy and Earle 1985). Unfortunately, to date, Caribbean archaeologists have largely ignored the economics of regional polities.

It is our contention that the unique characteristics of MC-6 reflect access to resources that were not readily available in Hispaniola. One aspect was access to the highly productive Caicos Bank that historically supported the export of millions of dried *Strombus gigas* to Haiti (Doran 1958; Hesse and Hesse 1977). In addition, access to salt provided a means to preserve fishes from the banks, especially bonefish (*Albula vulpes*) (O'Day 2002; Wing and Scudder 1983; Wing 2001). At this time, Hispaniola had large villages located in interior river valleys. Given the depauperate nature of the terrestrial environment, a significant and reliable source of marine protein must have been crucial for the maintenance of these communities. Moreover, the unusual stone foundation semi-pit structures at MC-6 make sense if these were used for the storage of marine protein prior to shipment to Hispaniola. These structures can be interpreted as storage pits above which wood and thatch houses were constructed (Keegan 2007).

Sullivan (1981) was correct in identifying MC-6 as a gateway community that served as the embarkation point for economic resources extracted in the southern Bahamas. What he failed to realize was the magnitude of this enterprise and its crucial importance in providing food and other resources to the large, interior settlements in Hispaniola. This case illustrates our conclusion that small land areas often provide access to significant marine resources and that such access was extremely important for the viability of communities that had primary access to agricultural produce. The cultivation of manioc can easily meet human caloric requirements, but without a reliable source of protein you cannot maintain a healthy and viable population (Keegan 1986). The importance of MC-6 reflects its role in supplying protein in a system of staple finance to the cacicazgos of Hispaniola.

## Carriacou

Carriacou is the southernmost island in the Grenadines chain of the Lesser Antilles, located approximately 250 km north of Venezuela. Although Carriacou is the largest island in the Grenadines (measuring 10.4 km from north to south, 8.7 km across at its widest point, and roughly 32 km$^2$ in area), it is small in comparison to the larger nearby islands of Grenada and St. Vincent, both of which are around 340 km$^2$ in area, over ten times its size. In contrast to most small islands in the Turks and Caicos and the Bahamas, for example, Carriacou is fairly high and mountainous, reaching heights of up to 290 m in both the island's northern and southern half.

Carriacou means "the land of many reefs," so it is perhaps not surprising to find that this island, in contrast to others in the region, has a much more extensive coral reef system with extensive fisheries (e.g., turtle, conch, lobster, reef and pelagic fish) which have been utilized for at least the past 1,500 years (see Fig. 2). Early reports by Bullen and Bullen (1972) and Richardson (1975: 392) testify to the strong presence of middens on Carriacou's windward coast and a recent archaeological survey on the island has identified 11 locations with evidence of prehistoric activity that date from the terminal Saladoid to the Suazan Troumassoid period (ca. AD 400–1200) (Fitzpatrick *et al.* 2005, 2007a; Kaye *et al.* 2005; LeFebvre 2007). Of these sites, Sabazan and Grand Bay on the east coast appear to have been the most intensively occupied. The abundance of material remains found during excavations at Grand Bay include two extremely rare stone zemis not found elsewhere in the southern Caribbean (Kaye *et al.* 2004: 85), and a substantial number of postholes, hearths, and human burials. Preliminary compositional analysis of pottery suggests that most ceramics on the island, similar to Grand Turk, were imported to the island from elsewhere, possibly Barbados, Puerto Rico, and/or South America (Fitzpatrick *et al.* 2008). Faunal refuse (particularly of marine taxa), support the notion that marine foods were a critical part of the diet for site inhabitants (LeFebvre 2007). In general, the island appears to have been a centerpiece for many economic activities in the southern Antilles during the Ceramic Age.

Preliminary analysis of vertebrate data (LeFebvre 2005a, b, 2007) suggests that inhabitants of Grand Bay were exploiting a wide range of near shore and offshore marine resources. Jack fish (Carangidae), parrotfish (Scaridae), and surgeonfish (Acanthuridae) were the most heavily exploited fish species and provided an important (and perhaps even a preferred) source of food. In addition, the sheer numbers of queen conch (*Strombus gigas*) shells in midden deposits at the site, along with other shellfish species, are further evidence for intensive marine predation.

What is perhaps most interesting about the faunal assemblages at Grand Bay is the abundance of sea turtle

(Cheloniidae) which is generally rare in Caribbean archaeological sites. At least four individual sea turtles have been identified from the upper-most layers (approximately 2.925 $m^2$ of soil) of the refuse midden at Grand Bay—two green sea turtles (*Chelonia mydas*) and two hawksbill sea turtles (*Eretmochelys imbricata)*. The midden is the most artifact dense area of the site and preliminary results include 581 individual sea turtle specimens with a total weight of 2,652.82 g. Although analysis of these and other faunal remains is still in progress, observations by the excavators (see also LeFebvre 2005a, 2007) suggest that they were not an anomalous component of Grand Bay subsistence, but an important dietary contribution. Hunting turtles on Carriacou is also recorded historically by the French who occupied Grenada in the mid-1600s. "Pottery fragments of turtle heads and corroborating evidence from Grenada indicate that sea turtles were a major part of the aboriginal diet" (Richardson 1975: 393). What will remain to be seen after more detailed analysis is whether the large quantity of sea turtle bone at Grand Bay is a result of butchering techniques (e.g., done on-site versus on the beach), for example, or simply one reason why peoples chose to settle the area.

Three types of mammals common to the Lesser Antilles are also present at Grand Bay, including the opossum (*Didelphis* sp.), agouti (*Agouti* sp.), and rice rat (*Oryzomys* sp.) (Newsom and Wing 2004), and reptiles including toads or frogs (Anura), iguanas (Iguanidae), and snakes (Serpentes). In addition, several other species which have rarely, or never been found in the Antilles—guinea pig, armadillo, and peccary—were also recovered from Grand Bay and Sabazan (LeFebvre *et al.*, submitted for publication). However, these taxa are minimal compared to the marine component.

Initial results from zooarchaeological analysis at Grand Bay show that marine animals dominate vertebrate exploitation, a common trend in the Caribbean during the Ceramic Age. Based on column samples in the upper most strata, reef fishes contribute the most marine biomass with 36% followed by inshore water animal biomass at 35%. Sea turtle makes up 97% of the total inshore water biomass. Offshore and pelagic marine animals contribute approximately 12% of the total sample biomass, and are dominated in weight by tuna or mackerel (Scrombridae) specimens. Terrestrial animals make up 17% of the total sample biomass and their presence and exploitability is likely tied to human agricultural activities (see LeFebvre 2005a, b for further discussion).

Grand Bay's proximity to multiple ecological habitats, including extensive coral reefs that stretch northward through the Grenadines, suggest that its inhabitants utilized a variety of procurement strategies including nets and weirs to capture schooling fish such as small-sized grunts (Haemulidae) and herrings (Clupeidae), a variety of parrotfish (Scaridae), as well as hook and lines to capture larger offshore fishes such as snapper (Lutjanidae) and tuna (Scrombridae) (LeFebvre 2005a). Although these taxa and procurement strategies are found elsewhere in the Caribbean, it is important to note that the site was settled earlier than, or contemporaneous with, the other nearby larger islands of Grenada, Barbados, and St. Vincent, similar to what is seen at Grand Turk and Middle Caicos. No islands from St. Vincent to Grenada have yet received the archaeological attention they deserve, but based on limited evidence, it appears that the density and size of sites on Carriacou is higher relative to size that is likely related to considerable marine resources in close proximity. Of particular note is the translocation of several animals from South America, although it is unclear what role they may have played in the overall subsistence strategy of the island's inhabitants.

## Small Cays in the Turks and Caicos Islands

The Bahamian Archipelago consists of more than 700 named islands, cays, and rocks. While only a relative handful support human populations today, in prehistory more of the smaller landmasses—tiny, even—were called home. Here we examine seven small, currently uninhabited islands in the context of regional economics and settlement patterns. We discuss three in detail: Pelican Cay off Middle Caicos and Middleton Cay and Long Cay near South Caicos. Four other sites will be discussed in more general terms.

### Pelican Cay

Pelican Cay lies approximately 1 km off the north shore of Middle Caicos near the modern hamlet of Bambarra. Although the surrounding waters are meters deep, Pelican Cay is connected to the mainland by a tombolo that is never more than chest deep at high tide. It is a comfortable, if moist, walk from the beach at Bambarra Landing.

Pelican Cay is very small, a mere 45×95 m, encompassing a total area of roughly 0.5 ha. In spite of its diminutive dimensions, there is clear evidence for recurring human activity dating as far back as a thousand years. Excavations at Pelican Cay in 2000 and 2004 yielded a wealth of prehistoric and colonial-era material culture, from ceramics executed in the Meillac style (800 to 1200 AD) and imported from Hispaniola, to kaolin pipe stems dating to the eighteenth century. Although it lies only 2.5 km from the village of MC-32, Pelican Cay seems to have been a place separate from life on the main island.

Pelican Cay is notable for the abundance of items associated with people of status in the Lucayan culture. Present in the deposits are a wide variety of non-local ceramics that were imported from the Greater Antilles, some 100 km to the south. That imported vessels dominated the ceramic assemblage is salient because the Lucayan people commonly used locally manufactured Palmetto ware ceramics that were fashioned from red soils and calcined conch shell. Palmetto ware is the rougher, thicker, technologically inferior, usually undecorated, utilitarian utensil of the Bahama islands, which dominates the assemblage at MC-32 and other contemporaneous sites on Middle Caicos.

The imported ceramics are primarily executed in the Chican style that is commonly associated with the Classic Taínos (circa AD 1200 to contact) (see Rouse 1992). As mentioned above, some vessels executed in the earlier Meillac style were recovered but not in substantial numbers and only at the bottom of the deposit. This early horizon was radiocarbon dated to cal AD 1080±50 (Beta 242675), suggesting that most of the activity occurred after that time. Much of the assemblage included smaller serving vessels. A few vessels of cooking size were present, but there were virtually no griddles, suggesting that food was usually being prepared elsewhere and brought to the island for consumption. Several forms of serving vessels were represented, including a punctate plate and a wide variety of adorned navicular (boat shaped) pots. An effigy pot formed in the shape of a stylized human face was also present. Moreover, a carved shell eye and half of a carved shell dental arcade were recovered. These would have been inlaid on a carved wooden zemi—a representation of some member of the Lucayan pantheon of supernatural beings. The presence of two round, roughly 4.25 m diameter patches of cleared and leveled ground suggest that structures had once been erected at the site.

By any estimation, the assemblage at Pelican Cay stands in stark contrast to that of neighboring contemporaneous sites MC-12 and MC-32 (Keegan 2007). It seems clear that people were using Pelican Cay for special reasons. The presence of the *cemí* inlays suggests a ritual usage for the island, perhaps as some form of shrine: a spatially distinct and limited-access sacred from the regular profane of village life. In sum, it would be imprudent to argue that Pelican Cay was a commonplace settlement. The role of Pelican Cay, and other sites like it, must be considered in any comprehensive analysis of Caribbean prehistory.

### Middleton Cay and Long Cay

Many small, currently uninhabited cays lie within sight of Cockburn Harbor, the main town on South Caicos. Examinations of several of these cays provide unique insight into the early settlement strategies in the Bahama archipelago.

Middleton Cay is a stingray-shaped speck of land that sits in the shallow Caicos Bank 5 km east of the southern tip of South Caicos. Today the island is 250×300 m at its maximum dimensions—at the time of occupation it was slightly smaller, according to the testimony offered by the sea-weathered, relic beach rock in its interior. Middleton Cay was a proto-Lucayan village. Meillacan ceramics dominate the lower deposits, which have been radiocarbon dated to cal AD 1150±55 (Beta 242673). Both the radiocarbon date and similarities in the ceramic assemblages suggest a relationship with MC-8 and MC-10 on Middle Caicos, which, as discussed above, are also Meillacan sites that date to the mid twelfth century AD. A clear transition to a Chican/Palmetto ware assemblage is superimposed on the earlier Meillacan deposits. A radiocarbon date from this horizon yielded results of cal AD 1410±40 (Beta 242674), which indicates that the site was regularly occupied for at least three centuries.

Given its location in the middle of the conch-rich Caicos Bank, it is not surprising that at Middleton, conch was extremely important. The island contains more than a dozen enormous middens of *Strombus* shells—most 2 m high, 6 m wide, and 20–30 m long—that extend out from the shoreline into the sea like quays at a modern port. At the bottom lie innumerable conchs with the tell-tale “Indian kill hole”; near the top are more conch contributed by South Caicos fishermen who add to the middens on a daily basis, as, apparently, their fathers did before them.

Middleton Cay currently escapes notice, but for several hundred years early in the last millennium it was a bustling community. Three easily discernable house floors, between 6 and 10 m in diameter, abut a clearly delineated oval-shaped plaza that extends 21 m on its precise north/south long axis. Eighteen 0.50×0.50 m test units confirmed that the plaza was intentionally constructed with beach sand. Additionally, a conch tool “workshop” was discovered. Fifty-one *Strombus* pick tools of varying dimensions and in various stages of manufacture were recovered from a single 10 cm level of a 1×2 m unit during the excavations. Conch implements, as well as conch meat, were likely staple exports of the Middleton Cay community.

Excluding conch, faunal remains at the site were relatively limited. This is most likely due to the unfortunate erosion of most of the site’s beachfront kitchen midden. Ringing the site is a bare-rock “beach” that is lapped by the water at high tide. Embedded in this rock are, amazingly, sherds of pottery, as if fossilized in situ eons ago. Prior hurricane action, including a massive, late-season storm that came from the southwest in 1926 (Brian Riggs, personal communication), very likely washed away the upper layers of this valuable archaeological resource, leaving only the impacted foundation. Nevertheless, it is clear from the surviving record that conch probably sustained the community through both consumption and trade in tool wares.

However, Middleton was not a fish camp. Although it is tempting to view sites in peripheral locales as such, the presence of multiple, large structures, the density and utilitarian nature of the ceramic assemblage, and, perhaps most important, a central plaza, indicate that the site's inhabitants were not transients. All available evidence indicates that Middleton Cay was an intensive, long-term occupation.

Long Cay is 4 km long but rarely more than 150 m wide. Its northern tip is a mere 800 m from the southern extreme of South Caicos. The island's windward side is elevated escarpment that exceeds 50 m high in places, and consists of limestone cliffs that are constantly scoured by wind, waves, and a persistent salt spray. The lee of the island is sheltered and faces the warm, shallow, calm waters of the Caicos Bank. Not surprisingly, it is on the lee side that we find all evidence of the island's first occupants.

The Spud site on Long Cay lies on sandy soil in a natural depression. Spud is the largest small cay site in the region, with dimensions approximately 90×30 m for a total area of 0.27 ha. It faces east with Middleton Cay clearly visible about 3.5 km away. Like Middleton, Spud is a multicomponent site. The earliest deposits are dominated by Meillacan ceramics and have been radiocarbon dated to cal AD 1130±50 (Beta 242672), which clearly suggests coevality with Middleton Cay, MC-8 and MC-10. Above that, there is a clear transition to Palmetto ware and imported pottery with Chican motifs that yielded two radiocarbon dates of cal AD 1330±40 (Beta 242670) and cal AD 1360±40 (Beta 242671). From this evidence, it appears that the site was occupied regularly from at least the early twelfth century perhaps until the late fourteenth century AD. This chronology is reinforced by the recovery of a small, carved greenstone zemi executed in Classic Taíno style (post AD 1200). This material is not native to the Bahamian archipelago.

There is evidence throughout the deposits that Spud's industry included an active bead-making enterprise. Bead blanks, finished beads, and bead-making implements were found on a regular basis. Beadmaking is a common activity in early sites in the Turks and Caicos Islands (circa AD 1100–1300), and the availability of *Chama sarda* shells may be one of the reasons that people were initially attracted to these islands (Carlson 1993; Sinelli 2001). There are no conch middens at Spud, although there is a substantial layer of burned and cracked conch shell that appears to have been intentionally deposited, perhaps in an effort to level off the site, which does slope considerably in places. In contrast to Middleton, the faunal record at Spud is well preserved; a variety of reef and pelagic fish, and terrestrial resources like birds and iguanas (which thrive on Long Cay today thanks to a recent reintroduction effort), are well represented.

If Spud and Middleton were contemporaries, then what was the relationship between the two sites? Keegan's (1992) concept of settlement pairs fits nicely with the data. Sites in the Caribbean grew until population reached a certain threshold at which time a portion of the population would relocate and establish a sister settlement nearby. These paired sites are usually found within 3–5 km of each other, fitting the distance between Middleton Cay and the Spud site on Long Cay. Residents of sister sites would continue to interact regularly, reinforced by kin relationships, social forces, and, importantly, economic ties. At Middleton and Spud, the economics are clear. Middleton would provide the conch meat found in such abundance on the Caicos Bank. Spud would produce the reef and pelagic fish, not common on the flat banks, as well as terrestrial resources like birds and iguana. Perhaps Spud also offered beads in trade, the raw material for which are abundant on the rocky shores of Long Cay, but rarer out on the Banks. Carbohydrates for all would have come from gardens scattered around the region—on nearby South Caicos, certainly, and perhaps on the southern, flatter, lands of Long Cay as well.

### Other Small Cay Sites

At least five other small, currently uninhabited islands harbored prehistoric residents. First we will review the sites on cays near South Caicos, then turn to islands across the Columbus Passage in the Turks Islands group.

With a total area of 80×80 m, Dove Cay is a minute, steep and rocky monolith that towers over the channel between South Caicos and Long Cay, about 1.5 km from Spud and 4 km from Middleton. A ceremonial bowl featuring enigmatic motifs that combine elements of both the Meillacan and Chican traditions was recovered on Dove Cay, suggesting that the site may have played a similar role to Pelican Cay for the residents around South Caicos. Unfortunately, the deposit is covered by as much as a meter of wind-blown sand and yielded insufficient evidence to draw any firm conclusions about the site's role in the local settlement strategy. Horse Cay lies 800 m north of South Caicos in the sheltered waters of Bell Sound. The island is roughly 200×60 m, with a total area of about 1.2 ha. Like Pelican Cay, one can walk to Horse Cay, although the deeper water makes travel more difficult. The site on Horse Cay is about 60×20 m (0.12 ha), but lies less than a meter above high tide. Consequently, much of the site has been eroded, although Meillacan and Palmetto ware ceramics were evident in the surface scatter. Finally, Plandon Cay lies directly north of the northern tip of South Caicos, extends approximately 1 km north-south, but is less than 200 m wide. The site on Plandon is approximately 50×25 m (0.12 ha) and features a substantial prehistoric-era conch midden. Excavations were not conducted at this site, so little else is known about its particular relationship to surrounding settlements. What is surprising is that the relatively large island of South Caicos has not produced evidence for sites of any substance despite several surveys of the island (e.g., Keegan 1985; Sullivan 1981).

Four small islands in the Turks group also boast sites. For example, Gibbs Cay is a 500×100 m (5 ha), hilly and rugged island situated 1.5 km east of the southeastern shore of Grand Turk. Excavations at the site in 2004 yielded a variety of imported ceramics, none of which bore any identifying decoration. Nevertheless, the relative dearth of Palmetto ware ceramics suggest that the site was occupied prior to the introduction of that style, which became common in the region after AD 1000, which fits with current evidence for Grand Turk where the four sites contain only imported ceramics, and was abandoned before AD 1300. The data suggest that Gibbs was not intensively occupied, and likely served as a fishing camp or temporary outpost for early colonists. Conch are abundant in the seagrasses that surround the island, as are reef fish and mollusks (e.g., *Cittarium pica*) that prefer rocky littoral habitats.

In addition, Cotton Cay, with approximately 100 ha of landmass, is the largest of the small cays in this area. It lies south of Grand Turk and harbors two sites, situated approximately 1.5 km apart on the sandy beaches of the island's northern shore. Surface reconnaissance at the western site and excavations at the eastern site indicate that the sites were likely contemporaries. The ceramic assemblages consist almost exclusively of Palmetto ware, suggesting that they were occupied later, perhaps close to contact. Neither site is particularly large, and the data demonstrate that neither supported an intensive occupation. As with Gibbs Cay, it is likely that these sites were transient or seasonal camps, settled for the purpose of obtaining locally available resources.

From the following evidence it is clear that indigenous peoples of this region viewed very small islands in a far more favorable light than anthropologists and archaeologists have ever appreciated. But why? As demonstrated earlier, access to arable land within walking distance need not restrict site selection. Given the sheltered waters of the Caicos Bank, all of the land needed to maintain carbohydrate security was a short distance away as were vital resources like fresh water, firewood, and materials for constructing shelter. With these elements taken care of, locating the village as near as possible to the marine resources upon which they relied for protein, tools, jewelry, and so forth becomes a logical choice. Moreover, small islands are simply more comfortable places to live. Unlike the larger, more sheltered islands, there is always a cooling sea breeze, and no stagnant swamps or *salinas* in which mosquitoes and other insect pest proliferate. These small islands also provide a clear view of surrounding waters, which promotes the defense of the community.

## Exploitation of Small Island Resources Through Time

As we have demonstrated through our analysis of Grand Turk, Carriacou, Middle Caicos, and several cays, small islands are not necessarily resource impoverished compared to larger islands. In fact, the inverse seems to be true. Based on archaeological investigations it is clear that marine resources on smaller islands in the Caribbean were abundant, heavily exploited, and even sought after by prehistoric Amerindians. Examples of this attractiveness include Grand Turk's giant iguanas (*C. carinata*), abundant sea turtles including an enormous loggerhead, and an extirpated tortoise. On Carriacou there appears to be an unusually large number of turtle remains and other marine foods that were also known and targeted by Europeans shortly after contact. The presence of several translocated animals, although in very small numbers, suggests that Carriacou's regional influence may be understated. And on Middle Caicos, salt production, coupled with extensive seagrass flats and patch reefs, seem to have made these smaller islands a focus for prehistoric peoples. On smaller islands around the Caribbean, humans have probably always sought out turtle nesting beaches, seabird rookeries, and productive fisheries.

The Cayman Islands may be the one exception. There turtle populations lay untouched until after European contact because they were not settled prehistorically, probably due to their very isolated location. Jamaican settlers instead targeted the turtle populations during the late 1600s and early 1700s prior to the advent of an established agricultural system. The loss of turtles to feed people on Jamaica eventually led to heavy overfishing of other species and by the early 1970s, it was "accepted as an established fact" (Jackson 1997: S29). Fisheries in Jamaica have never recovered, a situation that began centuries earlier (Keegan *et al.* 2003) and is not unique to the island, but seen region-wide. It should be noted that in the case of the Cayman Islands, although Little Cayman and Cayman Brac are fairly small (around 40 km$^2$ total), Grand Cayman is over 200 km$^2$ in area. And, the island group is adjacent to the deepest part of the Caribbean (the Cayman Trench) which extends nearly 7,700 m in depth, allowing for only fringing reef to develop, not the extensive shallow reef systems that are seen in the Bahamas, Turks and Caicos, and Grenadines, for example. Thus, the Cayman's represent somewhat of an enigma in the Caribbean in terms of prehistoric settlement and an exception in regards to small island resource activity.

The examples we have presented here suggest that small islands were explicitly targeted for their marine foods, that these provided essential protein for groups living on larger islands, and that permanent occupations may have, in some instances, occurred only after larger nearby islands had been permanently settled. We would argue that smaller islands, because of their extremely diverse and plentiful resource base, lie at the nexus to understanding human adaptation in island environments.

## Conclusions

There is a tendency to view human landscapes as terrestrial habitats. In this regard bigger is viewed as better. This bias is even more apparent when one assumes a long-term evolutionary perspective where larger land areas support denser human settlement and foster more complex forms of sociopolitical integration. To this can be added the misconception by some scholars that marine foods are insufficient to support prehistoric populations over the long-term (see Erlandson 2001 for a review). Our main point here is that the size of the land area is less important than the distribution of marine resources as evaluated in terms of the short-term goals of the inhabitants. As such, a relatively small land mass may be viewed as providing the optimal habitat, even when this habitat is not sufficient to support a large population over the long term.

Our case studies have emphasized this perspective. Grand Turk was occupied because it provided access to terrestrial and marine resources that were less abundant along the north coast of Hispaniola. The use of Grand Turk to extract these resources occurred despite the fact that the island could not support permanent habitations. The relatively small island of Carriacou was settled for much the same reasons, although this island did have sufficient arable land to support permanent settlements. The extensive marine habitats surrounding the island, however, apparently made it more attractive to colonists than the larger islands to the south and north (i.e., Grenada and St. Vincent). On Middle Caicos, MC-6 provided the potential for long-term agricultural production and an enormous marine bank from which resources could be captured. In addition, solar-distilled salt from Armstrong Pond provided the means to preserve fish for export to Hispaniola and future consumption. The complexity of MC-6 reflects its role in a system of staple finance that supported the cacicazgos of Hispaniola.

In each of these cases, relatively small land areas were situated in locations with abundant and important resource distributions. The pre-Columbian peoples of these islands used these resources to their advantage because the issue of island size was less important to them than the benefits accrued from using these islands.

In the same way that marine ecosystems have only recently been seen as having an important contribution to discussions of human impact (see papers in Rick and Erlandson 2008), so have smaller islands within archipelagoes been viewed as somewhat peripheral and less important than the larger ones. This is now changing, but it is curious why it has taken archaeologists much longer to recognize what historians, ecologists, and fisherman have known for centuries. Nonetheless, as the importance of smaller islands and marine resources within archipelagoes becomes more apparent, this will surely lead to better explanations of how patterns of prehistoric settlement, adaptation, and exploitation were structured over time.

With a steady increase in archaeological, ecological, and historical research in the Caribbean islands, it has now become necessary to combine our various areas of expertise to discuss issues of human adaptations, resource use, and impacts. Multidisciplinary approaches to conducting research in other parts of the world have proven useful for understanding temporal changes to both island and terrestrial environments. The Caribbean, by virtue of its relatively long history of human settlement, growing efforts to conduct palaeoecological and archaeological research, abundant historical records, and modern biological surveys (both terrestrial and marine), represents an untapped resource for examining human impacts and changes to island environments during the Holocene.

What we hope to have accomplished in this paper is a recognition that small islands in the Caribbean present new and exciting opportunities to explore human/environmental relationships. As our studies and others in the Pacific, for example, have shown (Allen and Schubel 1990; Ambrose 2002; Burley *et al.* 2003; Weisler 2003; Takamiya 2006; Jones *et al.* 2007), small islands have been attractive places for humans to exploit for thousands of years because of their great ecological diversity. But as a result, they are more prone to the consequences of human activities through time.

Although examining the impacts on smaller islands in the Caribbean has not been our objective in this paper, the data do indicate that baselines used for implementing conservation measures in and around these islands are probably erroneous, a likely victim of the "shifting baselines" phenomenon (see Pauly 1995; Bohnsack 2003; Myers and Worm 2003) where the baseline used for estimating the actual numbers and types of species needed to preserve an ecosystem are based on incomplete modern data.

After European contact, the trend of exploiting small island resources continued, although the impacts on fisheries have been greatest. For example, it is now known that large herbivores such as turtles (Carrillo *et al.* 1999) and manatees (see McKillop 1985; Mignucci-Giannoni *et al.* 2000), as well as numerous carnivores, are ecologically extinct on Caribbean seagrass beds and coral reefs, with food chains "now dominated by small fishes and invertebrates" (Jackson 1997: S28).

Over three decades ago, the geographer Bonham Richardson (1975: 398) acutely noted that Carriacou (although applicable to other small islands in the Caribbean) is "similar ..., but it is not a microcosm of the Caribbean in general. The island's very small size and correspondingly fragile biotic complex have made it more vulnerable than the larger islands to ecological disruption." This paper has emphasized the role that small islands have for understanding the successful settlement and adaptation of prehistoric peoples in the Caribbean, and that there are important implications for the long-term study of these islands to examine changes to resource diversity and exploitation.

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